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(54) Methods and apparatus for winding two-pole electric motor stators.

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Description

Background of the Invention

This invention relates to methods and apparatus for winding two-pole stators for electric motors. The machines which make use of this invention employ wire-guiding winding forms which are clamped to the stator during winding. Because stators may have different core heights, the methods and apparatus of this invention automatically position the winding forms and clamps to accommodate any core height.

In the machines presently used for winding electric motor stators, the winding forms typically comprise two half-forms fitted together (e.g., a male half having two pins and a female half having two holes respectively engaged by the pins of the male half). The two half forms, coupled together, form one element through which winding form clamps pass in order to pull the winding forms against the stator and lock the stator inside a housing which supports the stator during winding and other processing.

In the prior art machines the position of the clamps is usually adjusted manually from the front of the stator according to the height of the stator core so that the winding forms engage one another and the clamps by means of a central pin. The clamps then lock the winding forms against the stator, and therefore also against the stator housing containing said stator, by means of a mechanical operator.

A further prior art machine is disclosed in document US-A-3903593.

This document discloses clamp means which are mounted on either side of a transfer table for fixing winding forms to the stator. No reference is made in this document to accomodating variable size stators, nor, to automatically adjusting gear and rack mechanisms proposed for opening and closing the clamps in order to secure the winding forms to the stator.

In view of the foregoing, it is an object of this invention to provide simplified and improved methods and apparatus for winding electric motor stators.

It is a more particular object of this invention to provide methods and apparatus for winding electric motor stators which do not require all of the operations presently necessary to change the positions of the winding forms and clamps according to the core height of the stators being wound.

Summary of the invention

These and other objects of the invention are accomplished in accordance with this invention by providing winding apparatus and method for two-pole stators employing universal wire-guiding winding forms and clamps positioned automatically for any stator core height. The apparatus of this invention is preferably of the type in which the stator has a central longitudinal axis and first and second annular surfaces substantially perpendicular to said longitudinal axis at respective opposite ends of the cylindrical shape, said apparatus comprising: a housing for holding the stator; positioning means for respectively applying first and second winding forms to said first and second annular surfaces; first clamp means for releasably securing said first winding form in the position relative to said stator in which said positioning means applies said first winding form to said first annular surface; and second clamp means for releasably securing said second winding form in the position relative to said stator in which said positioning means applies said second winding form to said second annular surface; said apparatus being characterised in that it further comprises means for moving said first clamp means relative to said stator substantially parallel to said longitudinal axis so that said clamp means can be automatically adjusted to various stator dimensions parallel to said longitudinal axis; said first clamp means including a clamp member automatically movable for selectively engaging a latching surface to releasably secure said first winding form in said position relative to said various stator dimensions.

A method of winding a hollow electric motor stator is disclosed in Claim 9.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

Brief Description of the Drawings

FIGS. 1 and 2 are schematic top plan views of two different illustrative embodiments of this invention.

FIGS. 3 and 4 are, respectively, a top plan view and a side elevational view of another illustrative embodiment of the invention. Some of the elements shown in FIG. 4 have been removed for clarity in FIG. 3

FIG. 5 is a perspective view of a portion of the apparatus shown in FIGS. 3 and 4.

FIG. 6 is a partly sectional, side elevational view of a portion of the apparatus shown in FIG. 4. Note that for clarity, stator housing 12 is entirely omitted in FIG. 6.

FIG. 7 is a partial sectional plan view taken generally along the line VII-VII in FIG. 6.

FIG. 7a is a sectional view taken along the line C-C in FIG. 7.

FIG. 8 is a partial top plan view of detalil A in FIG. 6.

FIG. 9 is a partial elevational view taken along the line B in FIG. 8.

FIG. 10 is an elevational sectional view taken along the line X-X in FIG. 9.

FIG. 11 is an elevational view taken along the line XI-XI in FIG. 8.

FIG. 12 is a schematic view of the detail shown in FIG. 9 in a different operating position.

FIG. 13 is a partly sectional, elevational view of the winding forms and apparatus for positioning them inside the stator.

Detailed Description of the Preferred Embodiments

In Italian patent application 67196 A/88, filed March 10, 1988, the assignee of the present application disclosed a two-pole stator winder comprising a revolving table fixed to a base plate and rotating about its vertical axis. At least three equidistant working stations are placed radially in front of the table. These stations include (1) a station for loading the stator winder with an unwound stator from a conveyor system situated at one side of the machine and unloading the wound stator back onto the conveyor, (2) a winding station where one or more needles with alternate translational and angular motion provide for winding of the stator, and (3) at least one terminating station where manipulators terminate the leads to the stator. The revolving table, according to the present invention, is equipped with a plurality of stator housings. The distance between the stator housings is the same as the distance between the working stations. Each stator housing has a stator seat. The revolving table and the stator housings have mechanical means for bringing each stator housing (1) from a vertical orientation to a horizontal orientation as the stator housing moves from the loading and unloading station to the winding station, and (2) back to the vertical orientation as the stator housing moves from the terminating station to the loading and unloading station. The housings also have elastic means for keeping them in a horizontal orientation during their travel from the winding station to the terminating station(s). However, the machine shown in the 67196 A/88 application does not employ winding forms because that machine uses a type of winding needle motion which makes winding forms unnecessary.

The configuration of the machines which are the subject of this invention is generally similar to the machine shown in the 67196 A/88 application. Thus, as shown in FIGS. 1 and 2 herein, the machines of this invention typically have a revolving table 10 fitted to base 11 on which stator housings 12 are arranged crosswise. One such stator housing is shown in FIG. 5.

The embodiment shown in FIG. 1 has a loading station 13 in front of a conveyor 14, a winding station 15, and a terminating station 16. The alternative embodiment shown in FIG. 2 also has a loading station 13 in front of a conveyor 14 and a winding station 15, but in addition it has two terminating stations 16' and 16" instead of only one such station as in FIG. 1.

As can be seen in FIGS. 3 and 4, a stator housing 12 presents itself at loading and unloading station 13 with its axis vertical so as to allow arm 17 to pick up a stator 18 from conveyor 14, rotate around fulcrum 19, and place the stator inside the stator housing 12.

At the following winding station 15 and terminating station 16 the stator housings 12 have been pivoted 90 degrees so that their axes are horizontal, permitting processing of the stator. In the case where two terminating stations 16' and 16" are provided (see FIG. 2), the stator housing 12 can be rotated 180 degrees in traveling between stations 16' and 16". Downstream of the terminating station(s) the stator housing 12 is again pivoted 90 degrees to bring its axis back into vertical alignment in front of loading and unloading station 13.

The kinematic systems which may be employed for the above-mentioned 90 degree and 180 degree rotations of each housing 12 according to the working station it encounters during revolution of table 10 have been described in detail in Italian application 67196 A/88 and therefore need not be described again here, but will simpler be illustrated by one typical embodiment 20 shown in FIG. 5.

FIG. 4 shows in the center of the machine, fixed to revolving table 10, an assembly 21 for the insertion/removal of the upper half winding forms into/from the stator 18 inside housing 12 in front of loading and unloading station 13. A similar (but simpler) assembly 22 is located under the machine base for insertion/removal of the lower half winding forms. When arm 17 rotates 180 degrees from the position shown in FIG. 4 in order to bring stator 18 into housing 12, assembly 21 revolves around its vertical axle fixed to table 10 so as to remove assembly 21 out of the way of arm 17. When arm 17 returns over conveyor system 14, assembly 21 rotates back into working position over stator housing 12 which now contains stator 18.

Slide 23 (FIG. 6), actuated by a suitable cylinder, descends until stopping means 24 encounters the upper surface 25 of stator 18. (Note that stator housing 12 has been completely omitted for clarity in FIG. 6.) The other surface of stator 18 rests on reference points 26 (FIG. 5) of vertically oriented stator housing 12. Two rods 27, fixedly attached to each other and to slide 23, are located at an adjustable distance x from stopping means

24 and move together with slide 23. As slide 23 moves down, each rod 27 encounters a slide 28 (mounted on housing 12 as shown, for example, in FIG. 5) and pushes it downward. A typical slide 28 is better illustrated in FIGS. 8-11.

As each slide 28 is pushed downward by a rod 27, the slide compresses springs 29 (FIGS. 8 and 11) and sets to rotation gear 30 (FIGS. 8 and 10) which engages stationary rack 60 (FIGS. 8 and 9). Gear 30 is equipped with a one-way clutch or bearing 31 (FIG. 10) which prevents gear 30 from rotating in the direction opposite to the rotation produced by the descent of slide 28, thus preventing the slide from returning spontaneously upward when rod 27 no longer presses against slide 28.

In this way, when stopping means 24 contacts stator surface 25 (whatever its position, i.e., whatever the stator core height), slide 28 will have moved downward so that its clamp 32 (FIGS. 9 and 10) is lined up with opening 33 (FIG. 13) in winding form 34. At this point, cylinder 64 (FIG. 6) moves assembly 64′ (FIG. 7) forward until stopping means 39 (FIG. 10) encounters slide 28. This causes clamp 32 to enter opening 33. A cylinder 64″ (FIG. 7) is fixed to assembly 64 and pivotally attached to lever 35, which lever is pivotally attached to assembly 64′. Cylinder 64″ disengages lever 35 from head 36, thereby permitting spring 38 (FIG. 10), which is stretched between head 36 and slide 28, to hold clamp 32 in opening 33. (Note that elements 64, 64′, 64″, and 35 are duplicated to the right of the apparatus shown in FIGS. 6 and 7 so that the slide assemblies on both sides of stator housing 12 are controlled in the same way.)

As can be seen in FIG. 7, clamps 32 are shaped so as to protect the stator insulating material 32′ (typically paper) from the winding wire during winding. This is better illustrated in FIG. 7a where copper wire coil 32″ is shown resting on clamp 32 instead of on the ends of insulating papers 32′.

The upper portion of FIG. 13 illustrates the condition just described with clamps 32 inserted inside openings 33 of winding forms 34 which have already been lowered into stator 18 by slide 23 (FIG. 6). Now cylinder 40 moves rod 41, as illustrated in the lower portion of FIG. 13. In this way levers 42, moving along inclined sidewalls 43, open out and their tips 45 leave recesses 44 in winding forms 34. Winding forms 34 are therefore no longer held by assembly 21 (or 22 in the case of the portion of the apparatus below the stator). Rod 41 likewise moves inner levers 46. Levers 46 have slots 47 engaged by pegs 48. In this way levers 46 pivot until their free ends meet, so that their edges 49 disengage from heads 50 of pins 51. Pins 51, pushed by springs 52, move in apertures in winding forms 34 and pass through borings 53 in clamps 32. In this way clamps 32 and winding forms 34 are locked together and locked to stator 18. Slide 23, now without winding forms 34, returns to its home position shown in FIG. 6.

The revolving table now brings housing 12 with stator 18 and its winding forms 34 to winding station 15 and, after winding, to terminating station 16 or terminating stations 16′ an 16″ as described above. When stator 18 has been terminated, it returns to loading and unloading station 13 for removal of winding forms 34 before it can be returned to conveyor system 14. In order to remove winding forms 34, slide 23 is lowered until stopping means 24 contacts the surface 25 of stator 18. Now cylinder 40 causes levers 42 to engage winding forms 34 by means of projections 45, and also causes levers 46 to pull pins 51 through borings 53 out of clamps 32.

Cylinder 64 (FIG. 6) pushes forward assembly 64′ until lever 35 engages head 36, retracting it and pulling clamps 32 out of winding forms 34 through holes 33.

Because winding forms 34 are now free of clamps 32, slide 23 (with winding forms 34) returns back into the position illustrated in FIG. 6. A similar operation is carried out by assembly 22 (FIG. 4) which brings the lower half-forms down.

With slide 23 in the upper position, cylinder 55 (FIG. 6) moves rods 56 downwards. (Although only one rod 56 is shown in FIG. 6, it will be understood that there is another similar rod which acts on the right-hand slide assembly 28 as viewed in that FIG.) As can be seen in FIG. 12, each rod 56 pushes on the toggle 57 of the associated slide assembly 28. Toggle 57 is pivotally attached to fixed pivot 58 and at 59 to rack 60 which is pivotally attached to fixed point 61. As toggle 57 is straightened out by rod 56, rack 60 disengages from gear 30, thereby permitting slide 28 to be pushed up by springs 29. Now slide 28 is in its home position (shown in FIG. 6) waiting for a new stator. Rod 56 is then returned to its home position.

In order to prevent rack 60 from accidentally hitting or clashing with a tooth of gear 30 when the rack again engages gear 30 for processing a new stator, gear 30 carries saw-toothed wheel 62. An elastic catch 63 (FIGS. 8 and 9) positions gear 30 in its home position in such a way as to avoid the possibility of interference of the gear teeth with the rack.

The machine described above permits the winding of stators with different core heights with the aid of winding forms and without the need for manual adjustments at the station where the winding forms are applied to the stator. In particular, it has stopping means 24 which determines the stopping position of slide 23 according to the stator core height, while in consequence rods 27 bring

slide 28 into the exact position for inserting clamping means 32 into apertures 33. If the above assembly determining the position of the winding forms and of the clamping means according to the stator core height is controlled by electronic systems, it may pass the positioning information to the control system of the machine which in turn may use that information for a completely automated changing from one stator core height to another.

Claims

1. Apparatus for use in winding a hollow, substantially cylindrical electric motor stator (18), said stator having a central longitudinal axis and first and second annular surfaces (25) substantially perpendicular to said longitudinal axis at respective opposite ends of the cylindrical shape, said apparatus comprising: a housing (12) for holding the stator; positioning means (40-42) for respectively applying first and second winding forms (34) to said first and second annular surfaces; first clamp means (32) for releasably securing said first winding form (34) in the position relative to said stator in which said positioning means (40-42) applies said first winding form to said first annular surface; and second clamp means (32) for releasably securing said second winding form (34) in the position relative to said stator in which said positioning means (40-42) applies said second winding form to said second annular surface; said apparatus being characterised in that it further comprises: means (27, 28) for moving said first clamp means (32) relative to said stator substantially parallel to said longitudinal axis so that said clamp means can be automatically adjusted to various stator dimensions parallel to said longitudinal axis; said first clamp means including a clamp member (32) automatically movable for selectively engaging a latching surface (33) to releasably secure said first winding form in said position relative to said various stator dimensions.

2. The apparatus defined in claim 1 further comprising determining means (24) for determining the dimension parallel to said longitudinal axis of the stator core which needs to be wound so that said first clamp means can be automatically adjusted to said dimension.

3. The apparatus defined in claim 1 wherein said positioning means (40-42) comprises means (24) for contacting said annular surfaces of said stator to determine said dimension.

4. The apparatus defined in claim 1 or 2, wherein said positioning means (40-42) moves said first and second winding forms substantially parallel to said longitudinal axis in order to apply said first and second winding forms (34) to said first and second annular surfaces (25), and wherein said first clamp means (32) are mounted for releasably securing said first winding form in the position relative to said stator in which said positioning means applies said first winding form to said first annular surface; and wherein said positioning means (40-42) includes coupling means (27) for causing said first clamp means to move with said first winding form as said positioning means moves to apply said first winding form to said annular surface, said first clamp means further including retaining means (30, 31) for releasably retaining said clamp means in the position parallel to said longitudinal axis to which said clamp means is moved by said positioning means.

5. The apparatus defined in claim 1 further comprising means (35, 39) for controlling the position of said clamp member transverse to said longitudinal axis.

6. The apparatus defined in claim 5 further comprising urging means (38) disposed on said first clamp means for resiliently urging said clamp member to move into engagement with said latching surface; and means (35, 64", 64) for selectively causing said clamp member to move out of engagement with said latching surface (33).

7. The apparatus defined in claim 4 further comprising: means (56, 57) for selectively releasing said retaining means (30, 31).

8. The apparatus defined in claim 1 wherein said first clamps means further comprises: means (29) for resiliently urging said clamp means to remain in a home position which is its position prior to moving.

9. The method of winding a hollow, substantially cylindrical electric motor stator, said stator (18) having a central longitudinal axis and first and second annular surfaces (25) substantially perpendicular to said longitudinal axis at respective opposite ends of the cylindrical shape, comprising the steps of: positioning said stator in a housing (12); moving first and second winding forms (34) substantially parallel to said longitudinal axis in order to apply said first and second winding forms to said first and second annular surfaces; securing said first and sec-

ond winding forms to said first and second annular surfaces by means of first and second clamp members (32); the method being characterised by the following steps:

a) automatically adjusting the position of said clamp members (32) to various stator dimensions parallel to said longitudinal axis by moving said first clamp member relative to said stator;

b) automatically moving said first clamp member for selectively engaging a latching surface (33) to releasably secure said first winding form in said position relative to said various stator dimensions.

10. The method defined in claim 9 further comprising the step of determining the dimension parallel to said longitudinal axis of the stator core which needs to be wound so that the clamp members (32) can be automatically adjusted to said dimension.

11. The method defined in claim 10 further comprising the step of contacting at least one of said annular surfaces (25) of said stator to determin said dimension parallel to said longitudinal axis.

12. The method defined in claim 9 wherein said step of securing comprises the step of securing said winding forms (34) to said housing (12).

Patentansprüche

1. Vorrichtung zur Verwendung beim Wickeln eines hohlen, im wesentlichen zylindrischen Stators (18) für Elektromotoren, der eine Mittellängsachse und erste und zweite ringförmige Flächen (25) an den jeweiligen gegenüberliegenden Enden der zylindrischen Form aufweist, die im wesentlichen senkrecht zu der Längsachse sind; die Vorrichtung umfaßt: ein Gehäuse (12) zum Halten des Stators; Positioniereinrichtungen (40-42) zum jeweiligen Aufbringen von ersten und zweiten Wicklungsformen (34) auf die ersten und zweiten ringförmigen Flächen; eine erste Klemmvorrichtung (32) zum lösbaren Festhalten der ersten Wicklungsform (34) in der Position, relativ zu dem Stator, in welcher die Positioniereinrichtungen (40-42) die erste Wicklungsform auf die erste ringförmige Fläche aufbringen; und zweite Klemmvorrichtung (32) zum lösbaren Festhalten der zweiter Wicklungsform (34) in der Position relativ zu dem Stator, in welcher die Positioniereinrichtungen (40-42) die zweite Wicklungsform auf die zweite ringförmige Fläche aufbringen; die Vorrichtung ist dadurch gekennzeichnet, daß sie weiterhin umfaßt: Einrichtungen (27, 28) für das Bewegen der ersten Klemmvorrichtung (32) relativ zu dem Stator, im wesentlichen parallel zu der Längsachse, sodaß die Klemmvorrichtung automatisch auf verschiedene Statorgrößen, parallel zu der Längsachse eingerichtet werden kann; die erste Klemmvorrichtung enthält ein Klemmelement (32), das automatisch für das wahlweise Eingreifen mit einer Einrastfläche (33) bewegbar ist, um die erste Wicklungsform in der Position relativ zu den verschiedenen Statorgrößen lösbar festzuhalten.

2. Vorrichtung nach Anspruch 1, welche ferner eine Festsetzeinrichtung (24), für das Festlegen der Abmessung des zu bewickelnden Statorkerns parallel zu der Längsachse umfaßt, so daß die erste Klemmvorrichtung automatisch auf besagte Abmessung eingestellt werden kann.

3. Vorrichtung nach Anspruch 1, wobei die Positioniereinrichtung (40-42) Einrichtung (24) zum Abtasten der ringförmigen Flächen des Stators umfaßt, um besagte Abmessung zu bestimmen.

4. Vorrichtung nach Anspruch 1 oder 2, worin die Positioniereinrichtung (40-42) die erste und zweite Wicklungsform im wesentlichen parallel zu der Längsachse bewegt, um die erste und zweite Wicklungsform (34) auf die erste und zweite ringförmige Fläche (25) aufzubringen, und wobei die erste Klemmvorrichtung (32) zum lösbaren Festhalten der ersten Wicklungsform in der Position, relativ zu dem Stator, in welchen die Positioniereinrichtung die erste Wicklungsform auf die erste ringförmige Fläche aufbringt, vorgesehen ist, wobei die Positioniereinrichtung (40-42) eine Kupplungseinrichtung (27) enthält, die die erste Klemmvorrichtung dazu veranlaßt, sich mit der ersten Wicklungsform zu bewegen, so wie sich die Positioniereinrichtung bewegt, um die erste Wicklungsform auf die erste ringförmige Fläche aufzubringen, und wobei die erste Klemmvorrichtung weiterhin Halteeinrichtungen (30, 31) zum lösbaren Halten der Klemmvorrichtungen in der Position parallel zu der Längsachse umfaßt, zu welcher die Klemmvorrichtung durch die Positioniereinrichtung bewegt wird.

5. Vorrichtung nach Anspruch 1, weiterhin Einrichtungen (35, 39) umfassend, für das Steuern der Position der Klemmvorrichtung, quergerichtet zur besagten Längsachse.

6. Vorrichtung nach Anspruch 5, weiterhin ein Vortriebsmittel (38) umfassend, das auf der ersten Klemmvorrichtung angeordnet ist, für das federnde Vortreiben der Klemmvorrichtung, um sie in Eingriff mit der Verriegelungsfläche zu bewegen; und Einrichtungen (35, 64", 64), welche die Klemmvorrichtung wahlweise veranlassen, sich aus dem Eingriff mit der Einrastfläche (33) zu bewegen.

7. Vorrichtung nach Anspruch 4 weiterhin umfassend: Einrichtungen (56, 57) für das wahlweise Lösen der Halteeinrichtungen (30, 31).

8. Vorrichtung nach Anspruch 1, worin die erste Klemmvorrichtung weiterhin umfaßt: Mittel (29) für federndes Vortreiben der Klemmvorrichtung, um in einer Ruheposition, die ihre Position vor dem Bewegen ist, zu bleiben.

9. Verfahren zum Wickeln eines hohlen, im wesentlichen zylindrischen Stators (18) für Elektromotoren, der eine Mittellängsachse und erste und zweite ringförmige Flächen (25) an den jeweiligen gegenüberliegenden Enden der zylindrischen Form aufweist, die im wesentlichen senkrecht zu der Längsachse sind, mit den Verfahrensschritten: Positionieren des Stators in ein Gehäuse (12); Bewegen erster und zweiter Wicklungsformen (34) im wesentlichen parallel zu der Längsachse, um die erste und zweite Wicklungsform auf die ersten und zweiten ringförmigen Flächen aufzubringen; Festhalten der ersten und zweiten Wicklungsformen auf den ersten und zweiten ringförmigen Flächen mittels erster und zweiter Klemmvorrichtungen (32); das Verfahren ist durch die folgenden Verfahrensschritte gekennzeichnet:

   a) Automatisches Einrichten der Position der Klemmvorrichtungen (32) parallel zur Längsachse auf die verschiedenen Statorabmessungen durch Bewegen des ersten Klemmelementes relativ zu dem Stator;

   b) automatisches Bewegen der ersten Klemmvorrichtung für das wahlweise Eingreifen mit einer Einrastfläche (33) um die erste Wicklungsform in besagter Position relativ zu den verschiedenen Statorgrößen lösbar festzuhalten.

10. Verfahren nach Anspruch 9, mit dem weiteren Verfahrensschritt, daß die Abmessung des zu bewickelnden Statorkerns parallel zu der Längsachse, so daß die Klemmvorrichtungen (32) automatisch auf besagte Abmessung eingestellt werden können.

11. Verfahren nach Anspruch 10, mit dem weiteren Verfahrensschritt des Abtastens von zumindest einer der ringförmigen Flächen (25) des Stators, um besagte Abmessung parallel zur Längsachse zu bestimmen.

12. Verfahren nach Anspruch 9, worin der Schritt des Festhaltens den Schritt des Festhaltens der Wicklungsformen (34) an das Gehäuse (12) umfaßt.

Revendications

1. Appareil destiné à être utilisé pour bobiner un stator creux sensiblement cylindrique (18) de moteur électrique, ledit stator ayant un axe longitudinal central et des première et deuxième surfaces annulaires (25) sensiblement perpendiculaires audit axe longitudinal aux extrémités opposées respectives de la forme cylindrique, ledit appareil comprenant : un support (12) destiné à tenir le stator, des moyens de positionnement (40-42) destinés à appliquer respectivement des première et deuxième formes de bobinage (34) contre lesdites première et deuxième surfaces annulaires ; des premiers moyens de serrage (32) destinés à fixer ladite première forme de bobinage (34), de façon démontable, dans la position relative par rapport audit stator dans laquelle lesdits moyens de positionnement (40-42) appliquent ladite première forme de bobinage contre ladite première surface annulaire ; et des deuxièmes moyens de serrage (32) destinés à fixer ladite deuxième forme de bobinage (34), de façon démontable, dans la position relative par rapport audit stator dans laquelle lesdits moyens de positionnement (40-42) appliquent ladite deuxième forme de bobinage contre ladite deuxième surface annulaire ; ledit appareil étant caractérisé en ce qu'il comprend en outre : des moyens (27, 28) servant à déplacer lesdits premiers moyens de serrage (32) par rapport audit stator dans une direction sensiblement parallèle audit axe longitudinal, de sorte que lesdits moyens de serrage peuvent être ajustés automatiquement pour diverses dimensions du stator considérées dans la direction parallèle audit axe longitudinal ; lesdits premiers moyens de serrage comprenant un élément pince (32) qui peut être automatiquement déplacé pour attaquer sélectivement une surface de verrouillage (33) pour fixer ladite première forme de bobinage de façon démontable dans ladite position relative pour lesdites différentes dimensions de stators.

2. Appareil selon la revendication 1, comprenant en outre des moyens de détermination (24) servant à déterminer la dimension, considérée dans la direction parallèle audit axe longitudinal, du noyau du stator qui doit être bobiné, de manière que lesdits premiers moyens de serrage puissent être ajustés automatiquement sur ladite dimension.

3. Appareil défini dans la revendication 1, dans lequel lesdits moyens de positionnement (40-42) comprennent des moyens (24) destinés à entrer en contact avec lesdites surfaces annulaires dudit stator pour déterminer ladite dimension.

4. Appareil selon la revendication 1 ou 2, dans lequel lesdits moyens de positionnement (40-42) déplacent lesdites première et deuxième formes de bobinage sensiblement parallèlement audit axe longitudinal pour appliquer lesdites première et deuxième formes de bobinage (34) contre lesdites première et deuxième surfaces annulaires (25), et dans lequel lesdits premiers moyens de serrage (32) sont montés pour fixer ladite première forme de bobinage, de façon démontable, dans la position relative par rapport audit stator dans laquelle lesdits moyens de positionnement appliquent ladite première forme de bobinage contre ladite première surface annulaire ; et dans lequel lesdits moyens de positionnement (40-42) comprennent des moyens d'accouplement (27) servant à amener lesdits premiers moyens de serrage à se déplacer avec ladite première forme de bobinage lorsque lesdits moyens de positionnement se déplacent pour appliquer ladite première forme de bobinage contre ladite surface annulaire, lesdits premiers moyens de serrage comprenant en outre des moyens de retenue (30, 31) destinés à retenir lesdits moyens de serrage, de façon démontable, dans une position parallèle audit axe longitudinal, dans laquelle lesdits moyens de serrage sont déplacés par lesdits moyens de positionnement.

5. Appareil selon la revendication 1, comprenant en outre des moyens (35, 39) servant à commander la position dudit élément de serrage transversalement audit axe longitudinal.

6. Appareil selon la revendication 5, comprenant en outre des moyens de sollicitaion (38) disposés sur lesdits premiers moyens de serrage pour tendre élastiquement à mettre ledit élément pince en prise avec ladite surface de verrouillage ; et des moyens (35, 64", 64) servant à amener sélectivement ledit élément pince à se dégager de la prise avec ladite surface de verrouillage (33).

7. Appareil selon la revendication 4, comprenant en outre : des moyens (56, 57) servant à relâcher sélectivement lesdits moyens de retenue (30, 31).

8. Appareil selon la revendication 1; dans lequel lesdits premiers moyens de serrage comprennent en outre : des moyens (29) servant à solliciter élastiquement lesdits moyens de serrage pour qu'ils restent dans une position de repos qui est leur position avant leur déplacement.

9. Procédé de bobinage d'un stator creux, sensiblement cylindrique, de moteur électrique, ledit stator (18) ayant un axe longitudinal central, et des première et deuxième surfaces annulaires (25) sensiblement perpendiculaires audit axe longitudinal aux extrémités opposées respectives de la forme cylindrique, comprenant les étapes consistant à : positionner ledit stator dans un support (12) ; déplacer des première et deuxième formes de bobinage (34) sensiblement parallèlement audit axe longitudinal pour appliquer lesdites première et deuxième formes de bobinage contre lesdites première et deuxième surfaces annulaires ; fixer lesdites première et deuxième formes de bobinage auxdites première et deuxième surfaces annulaires à l'aide de premiers et deuxièmes éléments de serrage (32) ; le procédé étant caractérisé par les étapes suivantes :

a) ajuster automatiquement la position desdits éléments de serrage (32) sur les différentes-dimensions de stators considérées parallèlement audit axe longitudinal, en déplaçant ledit premier élément de serrage par rapport audit stator ;

b) déplacer automatiquement ledit premier élément de serrage pour attaquer sélectivement une surface de verrouillage (33) pour fixer ladite première forme de bobinage, de façon démontable, dans ladite position relative pour lesdites différentes dimensions de stators.

10. Procédé selon la revendication 9, comprenant en outre l'étape consistant à déterminer la dimension considérée parallèlement audit axe longitudinal du noyau du stator qui doit être bobiné de manière que les éléments de serrage (32) puissent être automatiquement ajustés à ladite dimension.

11. Procédé selon la revendication 10, comprenant en outre l'étape consistant à entrer en contact avec au moins une desdites surfaces annulaires (25) dudit stator pour déterminer ladite dimension considérée parallèlement audit axe longitudinal.

12. Procédé selon la revendication 9, dans lequel ladite étape de fixation comprend l'étape consistant à fixer lesdites formes de bobinage (34) audit support (12).

Fig. 1

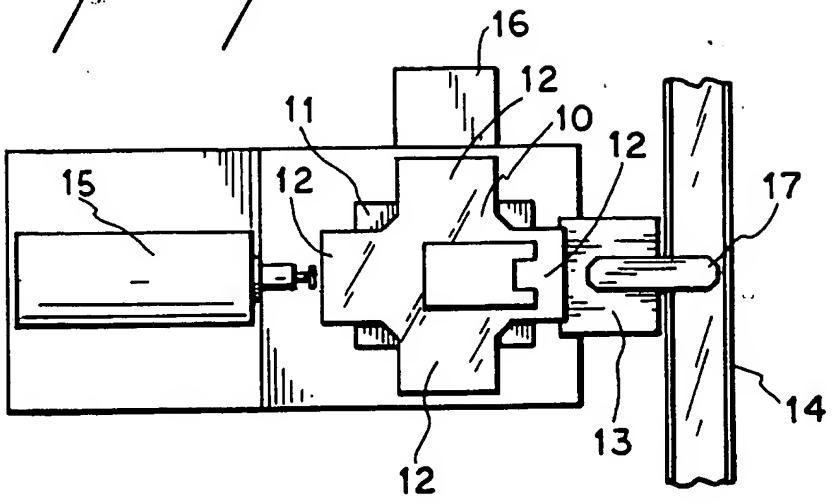


Fig. 2

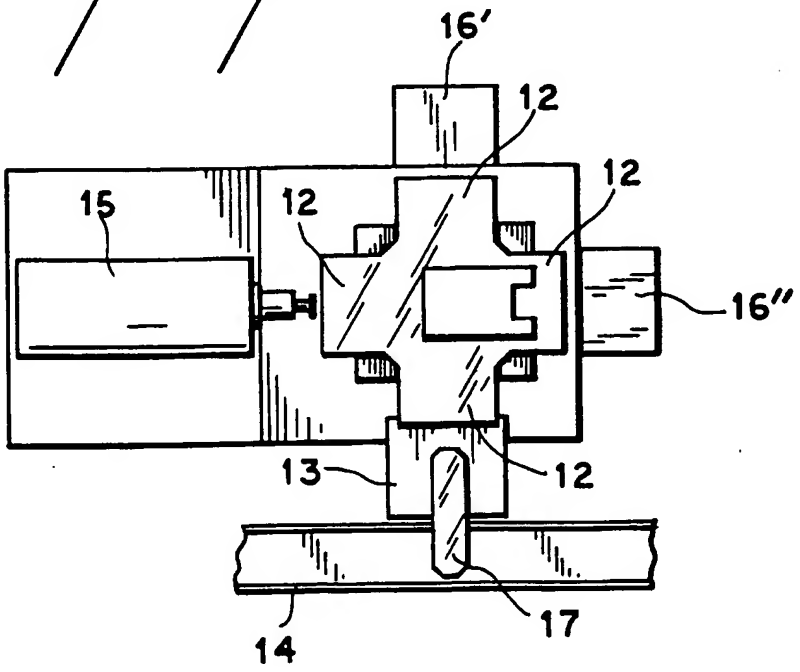


Fig. 3

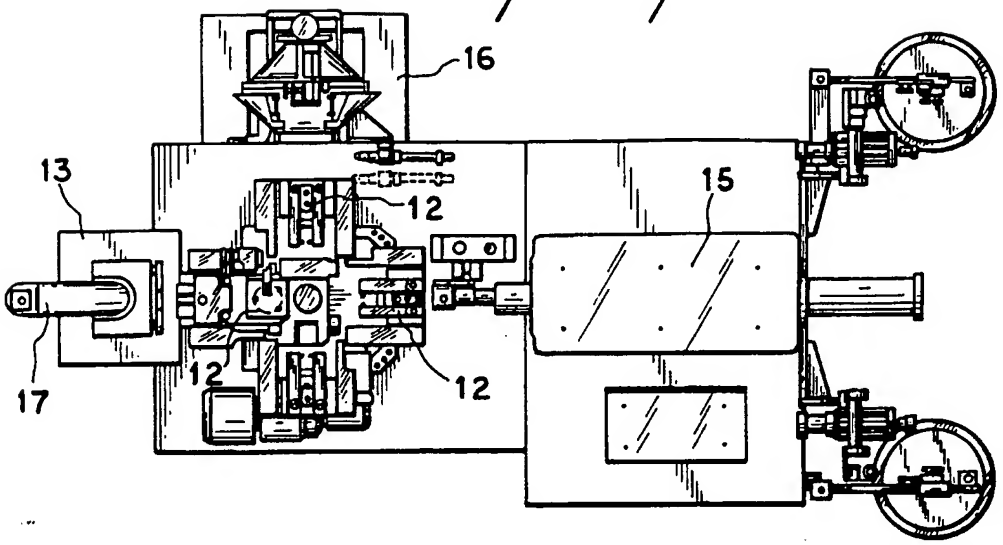


Fig. 4

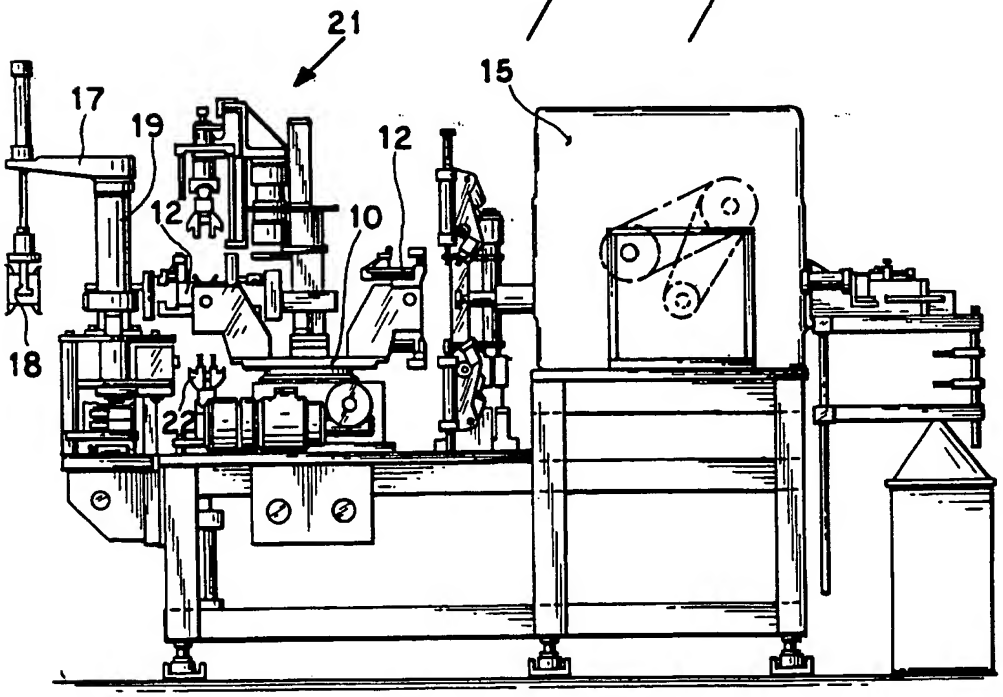


Fig. 5

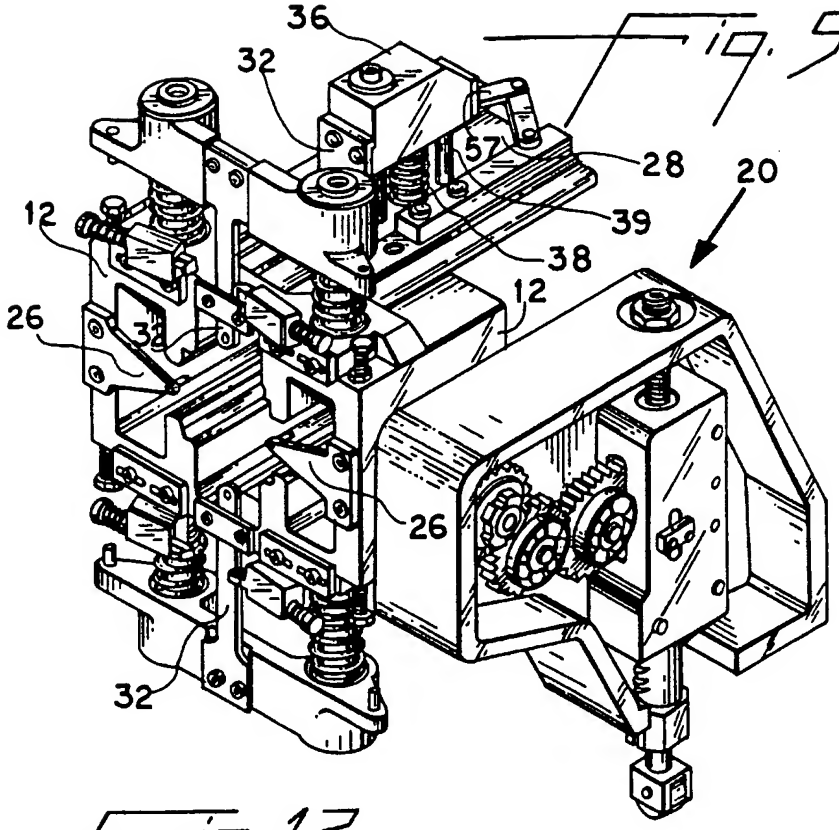


Fig. 12

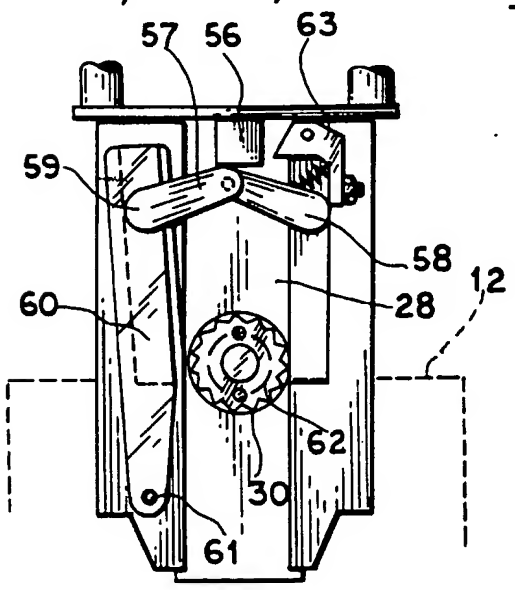


Fig. 7a

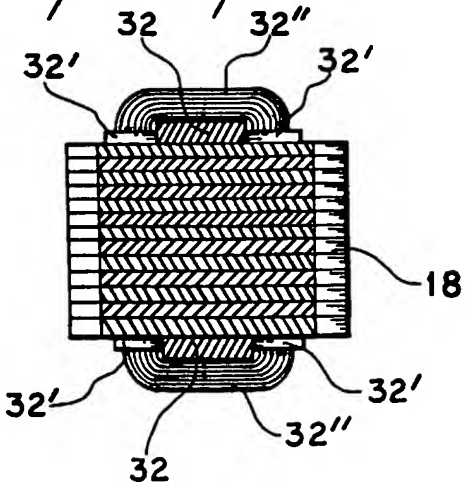
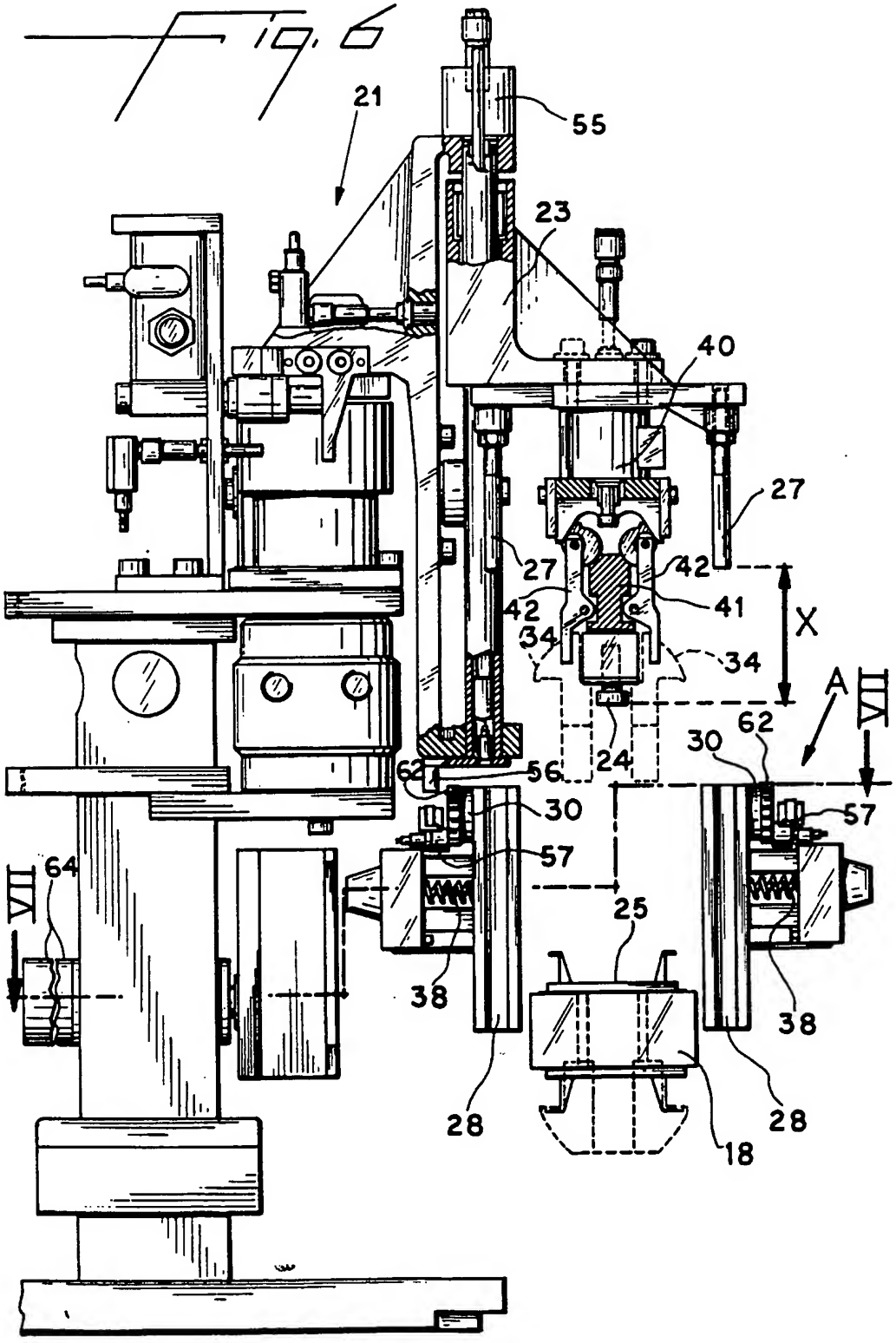


Fig. 6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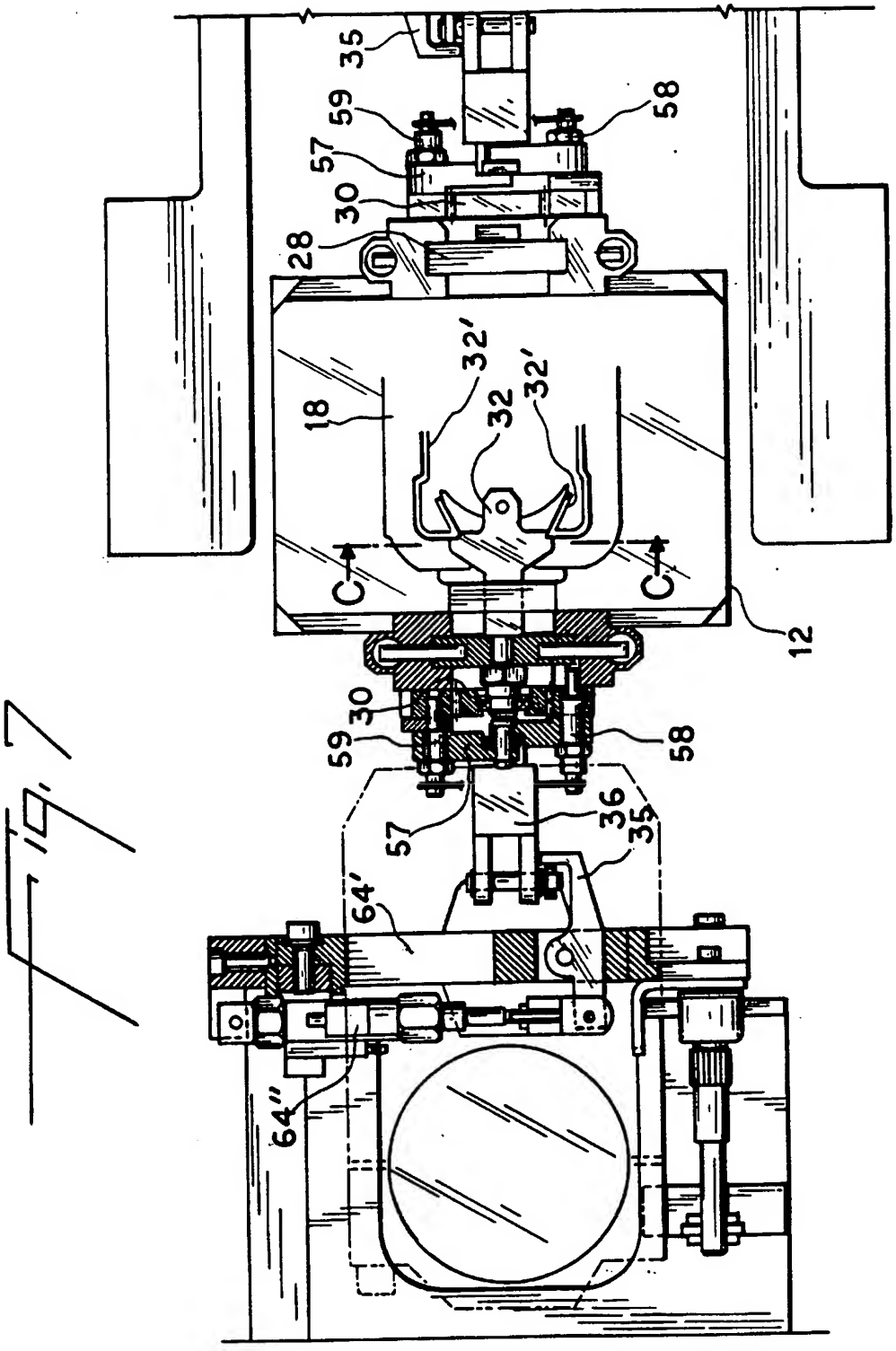

Fig. 7

Fig. 8

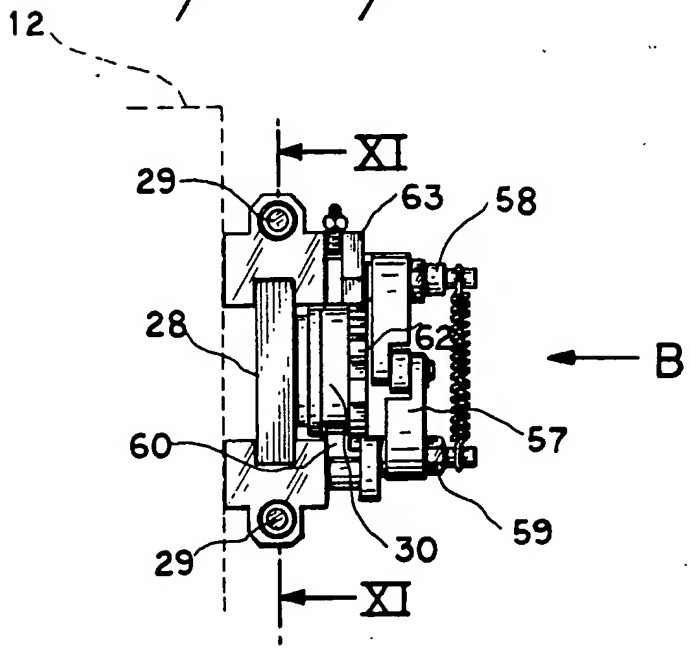

Fig. 11

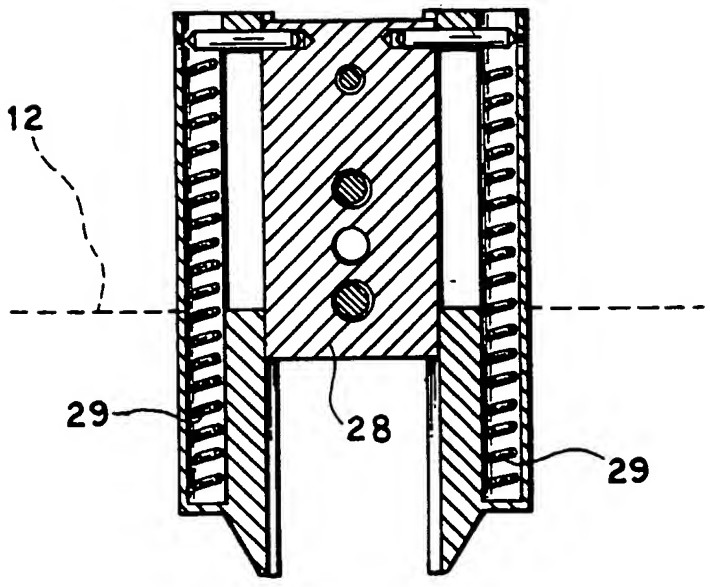

Fig. 9

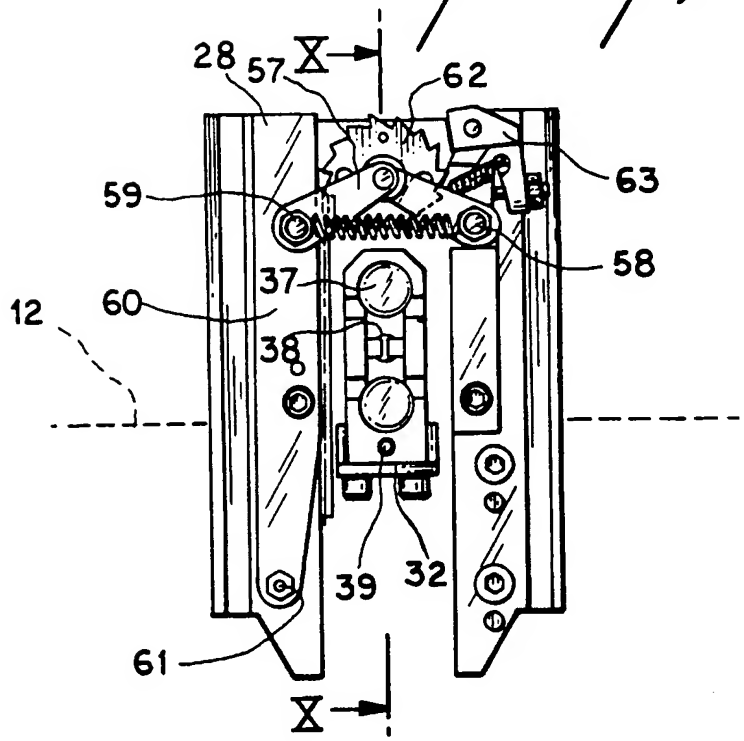
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Fig. 10

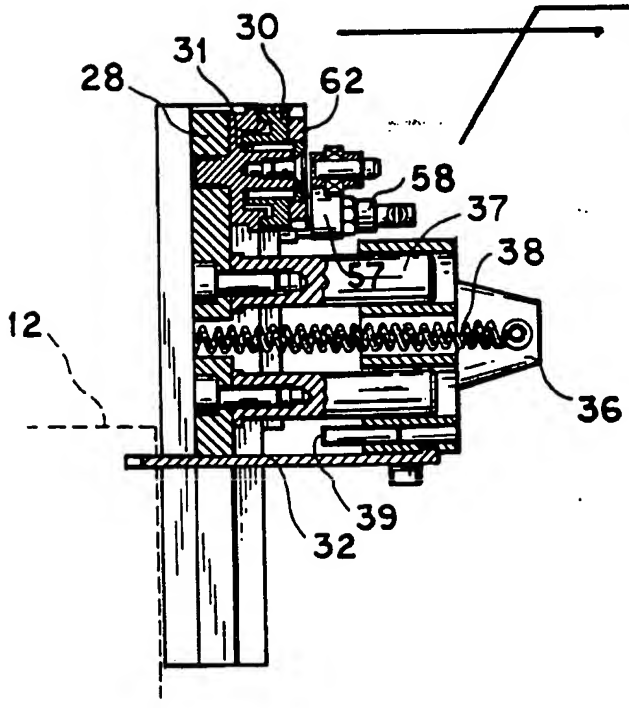
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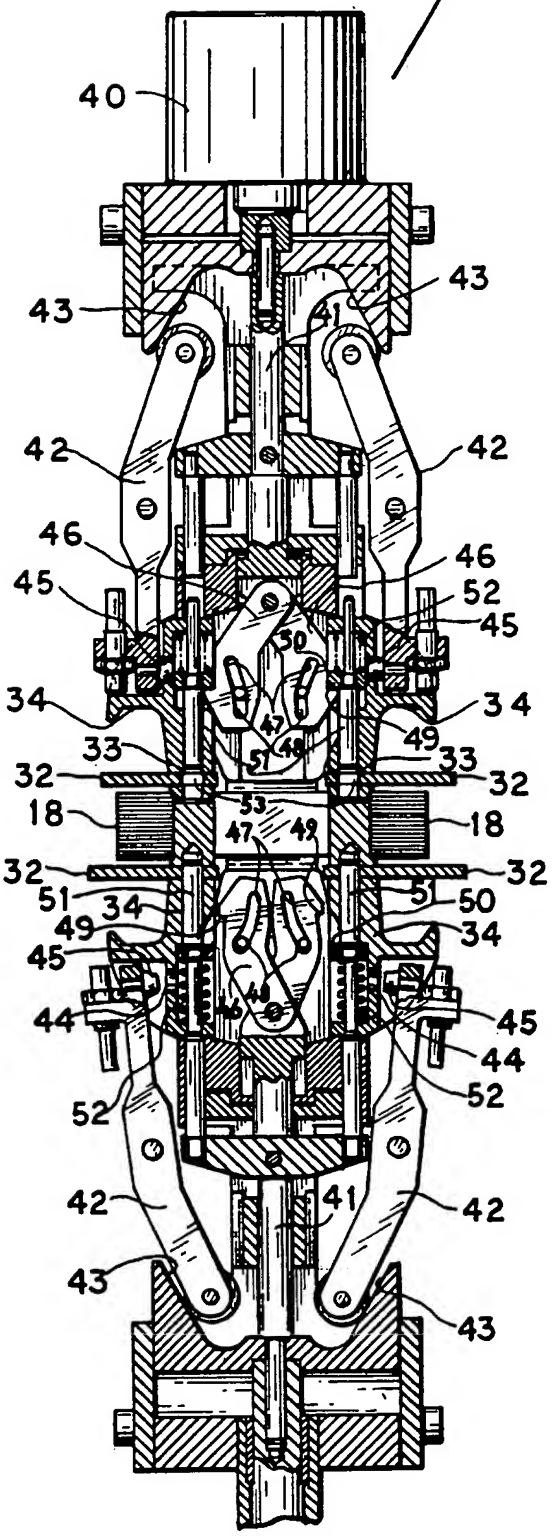
Fig. 13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